Claims

1. A method of implanting ions comprising the steps of:

(a) producing a volume of gas phase molecules of a boron hydride B_nH_m, where n and m are integers and $n > 10$ and $m \geq 0$;

(b) ionizing the boron hydride molecules defining ionized boron hydride molecules; and

(c) accelerating the ionized boron hydride molecules by an electric field into a target.

2. The method as recited in claim 1, in which step (a) comprises producing a volume of gas phase molecules of octadecaborane, $B_{18}H_{22}$.

3. The method as recited in claim 2, in which step (c) comprises accelerating molecules of $B_{18}H_x^+$, where $0 \leq x \leq 22$.

4. The method as recited in claim 2, in which step (c) comprises accelerating molecules of $B_{18}H_x^-$, where $0 \leq x \leq 22$.

5. The method as recited in claim 1, in which step (a) comprises producing a volume of gas by sublimation of a solid by heating above 20°C.

6. The method as recited in claim 1, wherein said step (c) comprises accelerating said boron hydride ions into a silicon target.

7. The method as recited in claim 1, wherein step (c) comprises accelerating boron hydride ions into a silicon-on-insulator substrate target.

8. The method as recited in claim 1, wherein step (c) comprises accelerating boron hydride ions into a strained superlattice substrate target.

9. The method as recited in claim 1, wherein step (c) comprises accelerating boron hydride ions into a substrate a silicon germanium (SiGe) strained superlattice target.

10. A method of implanting ions comprising the steps of:

(a) producing a volume of gas phase molecules of a boron hydride B_nH_m, where n and m are integers and $n > 10$ and $m \geq 0$;

(b) forming a plasma containing boron hydride molecules, boron hydride ions and electrons; and

(c) accelerating the boron hydride ions by an electric field to implant into a target, to perform doping of a semiconductor.

11. The method of claim 10, wherein said electric field is a time-varying or pulsed electric field.

12. The method of claim 10, wherein said electric field is a constant or DC electric field.

13. The method as recited in claim 10, in which step (a) comprises producing octadecaborane vapor, $B_{18}H_{22}$.

14. The method as recited in claim 10, in which step (b) comprises forming a plasma of $B_{18}H_x^+$ ions, where $0 \leq x \leq 22$.

15. The method as recited in claim 10, in which step (a) comprises producing a volume of gas by sublimation of a solid by heating above 20C.

16. The method as recited in claim 10, wherein step (c) comprises accelerating said boron hydride ions into a silicon target.

17. The method as recited in claim 10, wherein step (c) comprises accelerating said boron hydride ions into a silicon-on-insulator substrate target.

18. The method as recited in claim 10, wherein step (c) comprises accelerating said boron hydride ions into a strained superlattice substrate target.

19. The method as recited in claim 10, wherein step (c) comprises accelerating said boron hydride ions into a silicon germanium (SiGe) strained superlattice target.

20. A magnetic yoke assembly for generating a magnetic field, the magnetic yoke assembly comprising:

a yoke formed from a pair of pole pieces ;

a pair of permanent magnets having opposing North and South magnetic poles disposed between said pole pieces forming a yoke assembly; and

a pair of aligned apertures formed in said pole pieces.

21. The magnetic yoke assembly as recited in claim 20, where in said permanent magnets are configured such that said North and South magnetic poles of said permanent magnets are aligned.

22. A magnetic yoke assembly comprising:

a magnetic coil wound about a first axis; and

an upper yoke and a lower yoke magnetically coupled to opposing ends of said magnetic coil, said upper and lower yokes formed with aligned apertures configured such that a line through said aperture is generally parallel to said first axis.

23. The magnetic yoke assembly as described in claim 22, further including a pair of pole pieces magnetically coupled to extending ends of said upper and lower yokes.

24. A method for forming a metal oxide semiconductor (MOS) device having a substrate, the method comprising the steps of:

(a) forming a well and opposing trench isolations in a first region of said substrate;

(b) forming a gate stack on said substrate between said opposing trench isolations defining exposed portions of said substrate; said formation comprising the steps of *i)* depositing or growing a gate dielectric; *ii)* depositing a polysilicon gate electrode, and *iii)* patterning to form the gate stack.

(c) depositing a pad oxide onto said exposed portions of said substrate and on top of said gate stack;

(d) implanting $B_{18}H_x^+$ ions to form drain extensions between said gate stack and said opposing trench isolations;

(e) forming spacers adjacent said gate stack;

(f) implanting P- type cluster ions to form source and drain regions;

(g) providing heat treatment to activate material implanted by said doping step, thereby forming a P- type metal oxide semiconductor (MOS) device (PMOS).

25. The method as recited in claim 24, further including the steps of:

(a) isolating first and second regions on said substrate;

(b) forming said PMOS device in a first region; and

(c) forming an NMOS device in a second region.

26. The method as recited in claim 25 wherein step (c) includes implanting N-type cluster ions in said second region.

27. The method as recited in claim 26, wherein said N-type cluster ions are As_4H_x+, where $0 \leq x \leq 6$.

28. An ion source comprising:

a source of gas;

an ionization chamber in fluid communication with said source of gas, said ionization chamber formed with one or more electron entrance apertures, for receiving one or more electron beams, an ion extraction aperture for enabling an

ionized beam to be extracted and a gas inlet aperture, said ionization chamber configured to enable ionization of said gas by electron bombardment;

one or more electron sources for generating one or more electron beams, said electron source disposed outside of said ionization chamber; and

a first source of magnetic flux for generating a magnetic field within said ionization chamber, said source including a magnetic yoke assembly disposed outside of said ionization chamber.

29. The ion source as recited in claim 28, wherein said magnetic yoke assembly includes a permanent magnet.

30. The ion source as recited in claim 28, wherein said magnetic yoke assembly includes an electromagnet.

31. The ion source as recited in claim 28, wherein said one or more electron sources are configured so that said electron beam is generally parallel to the plane or planes containing the one or more electron entrance apertures, further including one or more beam steerers for bending said one or more electron beams so as to be generally perpendicular to the plane or planes containing said one or more electron entrance apertures.

32. The ion source as recited in claim 28, wherein each of said one or more beam steerers includes a second source of magnetic flux.

33. The ion source of claim 28, further including a magnetic shield between said electron sources and said magnetic yoke assembly, to substantially prevent the field produced by said magnetic yoke assembly from penetrating into the region of said electron sources.

34. A vapor source for an ion source, the vapor source comprising:

a vaporizer body defining a volume for receiving a crucible;

a conduit in fluid communication with said crucible;

at least one shut off valve coupled to said conduit;

a source block formed with a vapor conduit which forms a vapor feed for an ionization chamber; and

a multiple-stage temperature system for controlling the temperature of said vaporizer body, at least one shut off valve and source block separately.

35. The vapor source as recited in claim 34, wherein said crucible and vaporizer body volume are close-fitting, the gap between them being filled with gas to provide thermal contact between said crucible and vaporizer body volume.

36. The vapor source as recited in claim 35, wherein said gas is at or near atmospheric pressure.

37. The vapor source as recited in claim 35, wherein said gap is separated from vacuum by vacuum seals.

38. The vapor source as recited in claim 34, wherein said multiple-stage temperature control system includes resistive heaters in thermal contact with each of said vaporizer body, at least one shut off valve and said source block, said vapor source also including a multiple-stage temperature controller for controlling said resistive heaters.

39. The vapor source as recited in claim 38, wherein said multiple stage temperature controller is a three stage temperature controller for enabling the temperatures of said vaporizer body, at least one shut off valve and source block to be controlled separately.